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ABSTRACT

The document measures the spatial patterns of mental abilities of 94 seventh-grade students within a small town by correlating and mapping four variables--IQ test scores, achievement test scores, neighborhood quality as seen by town officials, and creativity test scores from the Torrance Tests of Creative Thinking. Objectives were to ascertain the spatial patterns of IQ, achievement, and creativity test scores, and to examine their spatial association with socioeconomic conditions, using the conclusions to draw implications about the cultural bias of the tests. The Kendall Rank Correlation was used to determine the statistical relationship among the study data, and isopleth maps were drawn identifying the spatial pattern of each variable, using the socioeconomic variable as a control. Findings showed IQ scores to be significantly associated spatially with achievement scores and neighborhood quality, while the creativity measures were not significantly associated with the other variables. The spatial association of IQ, achievement, and socioeconomic conditions supports the argument that the two tests are culturally biased. The fact that creativity tests are not spatially associated with the other variables suggests that these tests are not culturally biased and can be used to identify potentialities in culturally disadvantaged children. The study implies that children in lower ability classes within individual schools are segregated according to their performance on tests biased against them. (CK)

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THE SPATIAL PATTERN OF INTELLIGENCE IN A SMALL TOWN

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INTRODUCTION

The central question examined in this study is this: Are there spatial patterns of intelligence within a small town? My purpose for examining this question is personal in nature. As a public school teacher in a suburban school system of a large metropolitan area I became aware of an unspecified geography of intelligence which affects many people's choice of where to send their children to school and, therefore, their choice of where to reside. This undrawn mental map also affects employment preferences among many teachers. I have often wondered if such mental images of residential space would be a less significant factor influencing choice of school and residence in a small town where fewer schools are available from which to choose. Nothing could be farther from the truth in the small town where this study was conducted. (1)

While conducting the study I talked with numerous realtors in the study area. All of them emphasized the boundary between the city and the "more desireable" county school systems as a critical factor influencing residential choice in the area. Because of recent annexations several areas now within the city limits remain within the county school district. The school system boundary may be the best known boundary in the area, surpassing even the city limit and county boundaries in general recognition. When questioned about the nature of the difference between the two areas, these realtors typically responded that the children within the city school district are generally inferior intellectually to those in the other system because of their socio-economic circumstances. Although no available evidence supports this contention, many people in the community share the belief and the resultant mental maps affecting school and residential choice. For example,

a typical "house for sale" advertisement in the local newspaper states "in the city, but in the county school district".

As a geographer it occurred to me that a map representing spatial patterns of intelligence would settle the issue. By simply plotting the distribution of students and some measure of their intelligence, such as IQ or achievement test scores, and examining the patterns, if any, of the score values one could evaluate the seemingly popular hypothesis that kids in some areas are more intelligent than those in others.

Studies by educational psychologists leave little doubt that IQ, achievement, and socio-economic conditions are closely associated variables. (2) These studies support the currently popular argument that IQ and achievement tests are culturally biased, especially against culturally disadvantaged children. But none of these studies includes in its methodology maps which would show whether spatial patterns of these variables correspond. If these studies are correct, such maps should support the argument about cultural bias in these tests. (3)

Other studies by educational psychologists conclude that IQ, achievement, and other standard diagnostic tests fail to measure all of the intellectual attributes, or abilities, of children. (4) They may, in fact, mask other important mental abilities, especially among disadvantaged children. (5) One mental ability not measured directly by standard intelligence tests is creativity. The "Torrance Tests of Creative Thinking" offer a measure of creative thinking abilities. Torrance believes that measures derived from his tests can be used by school psychologists, counselors, and teachers to identify potentialities that might otherwise be overlooked, especially in looking for giftedness in culturally disadvantaged children. (6) He cites evidence from various studies throughout the United States which suggests that overall his tests are not culturally biased. (7) The

focus of my study, therefore, was enlarged to include measures derived from the Torrance Tests.

To examine the central question of the study, "Are the spatial patterns of mental abilities in the study area?", the following questions had to be addressed:

1) Are there spatial patterns of IQ and achievement scores within the study area?
2) Are these patterns spatially associated with socio-economic conditions?
3) How do the measures derived from the Torrance Tests of Creative Thinking behave spatially?

If IQ and achievement tests are culturally biased, as the literature suggests, their spatial patterns will closely resemble the spatial pattern of socio-economic conditions. If the Torrance Tests of Creative Thinking are not culturally biased, as Torrance suggests, the spatial patterns of creativity so measured should be dissimilar to those of IQ, achievement, and socio-economic conditions.

PROCEDURE

The Study Area. The study was conducted within the city limits of a small town. Two public school systems, County and City, and two private schools serve the area. The latter two were excluded from the study for various reasons, including their apparent lack of interest in the study. The existence of the county school district within the city resulted from citizen pressure to retain the old boundary after recent annexation of land by the city. Although residential areas beyond the city limit are functionally tied to the city, they were omitted from the study due to time

and financial constraints.

Data Collection. Ninety-four seventh grade students residing within the study area were the subjects of the study (Figure 1). IQ and achievement test scores and the home address of each student were obtained from the guidance counselor in each school system. Figural Form A of the Torrance Tests of Creative Thinking was administered to the students. This test was selected over the Verbal Test because it is more convenient to administer and evaluate. The test consists of three parts and provides measures of four kinds of creative thinking: originality, fluency, flexibility, and elaboration.

The originality score is determined by the frequency with which a student's response to a task is repeated by a national norm group. The less typical a student's response, the higher the originality score. Fluency is determined by the number of tasks completed during the test. Flexibility is measured by the number of different types of responses made. Elaboration is measured by the number of ideas in addition to the basic idea that the student adds to each figure. Raw scores for each measure were related to a standard score table to derive comparable scores. (8)

An index of neighborhood quality within the area was obtained from city officials. These individuals classified general neighborhood quality on a scale from one to ten at points evenly distributed within the study area. These control points were used in isopleth mapping.

Data Manipulation. The statistical correlation, or relationship, among the study variables was determined. Although the product-moment coefficient of correlation is often used to measure the degree of relationship among measures of mental abilities, doubt exists as to the validity of using this technique with these data. (9) The problem centers on the level of measurement of the data. Is it proper to treat measures of mental abilities such as IQ, achievement, and creativity as interval level data? Jensen

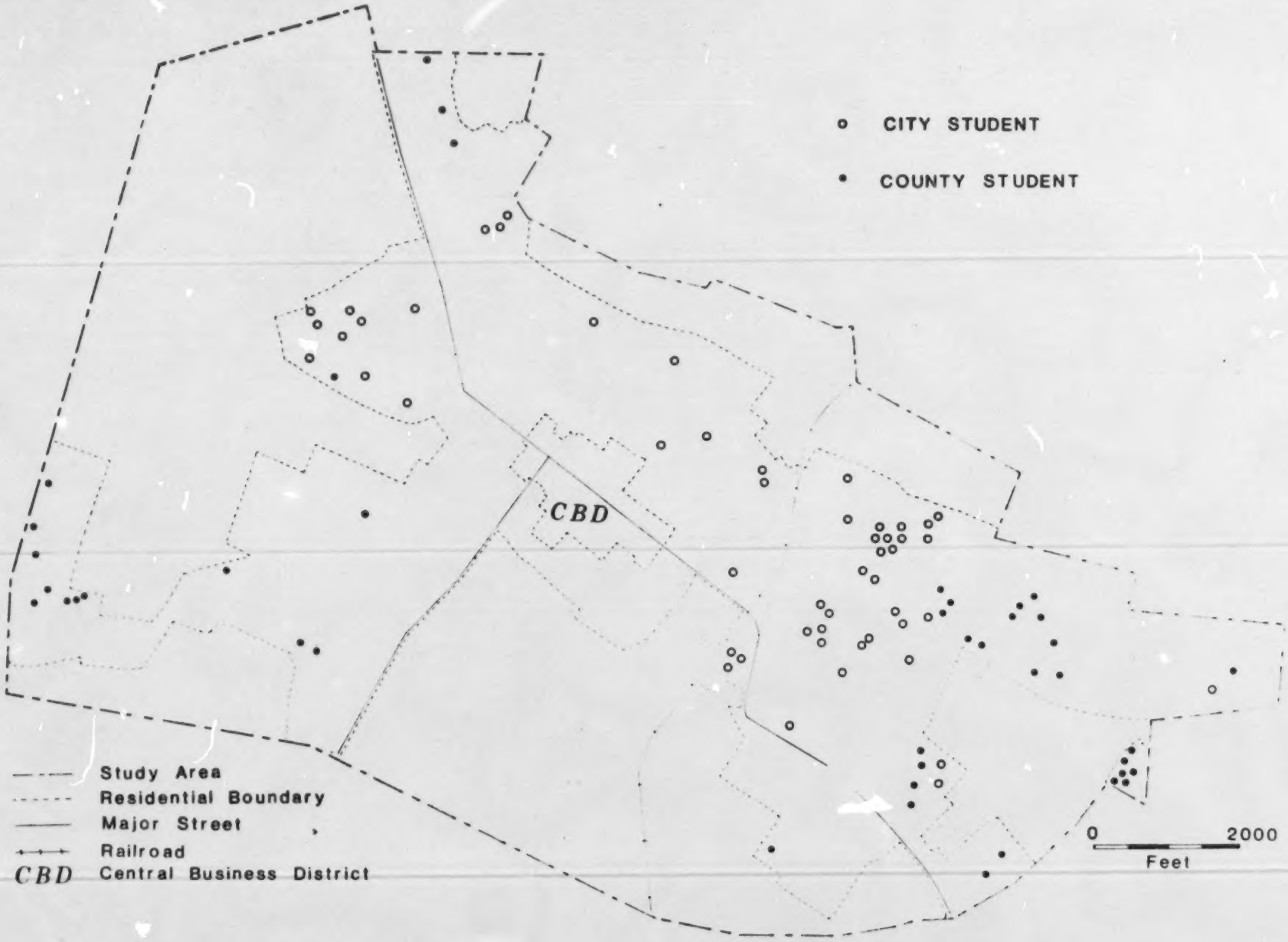

Figure 1. Locations of 94 Seventh Grade Students by Residence.

holds that it is reasonable to do so, but he states that uncertainty exists. (10) Correlation analysis using the product-moment coefficient technique is appropriately used with interval and ratio level data. (11) However, if measures of mental abilities are ordinal level data, the product-moment correlation technique is inappropriate; and a rank-correlation technique should be used. (12) To void this debate, the Kendall Rank Correlation technique was used to determine the statistical relationship among the study data.

Data Mapping. The study area was organized into equal size data zones after Barnes' "floating circle" isopleth mapping technique. (13) Each zone, or control area, is represented by a control point located at its center. These points, therefore, are evenly distributed through the study area (Figure 2). Each student's score for each test was plotted at his place of residence. The median value occurring within a control area was computed and recorded at the control point location. Control point values for each variable were examined on histograms and critical values for class intervals were chosen. Isopleths representing these values were drawn to identify the spatial pattern of each variable.

FINDINGS

Kendall Rank Correlation Coefficients suggest degree of relationship between variables examined for the 94 students (Table 1). The correlation matrix indicates that IQ and achievement are significantly associated but that neither of them is as strongly related to either of the creativity measures. This finding reaffirms what others have observed. (14) But how are these variables related spatially?

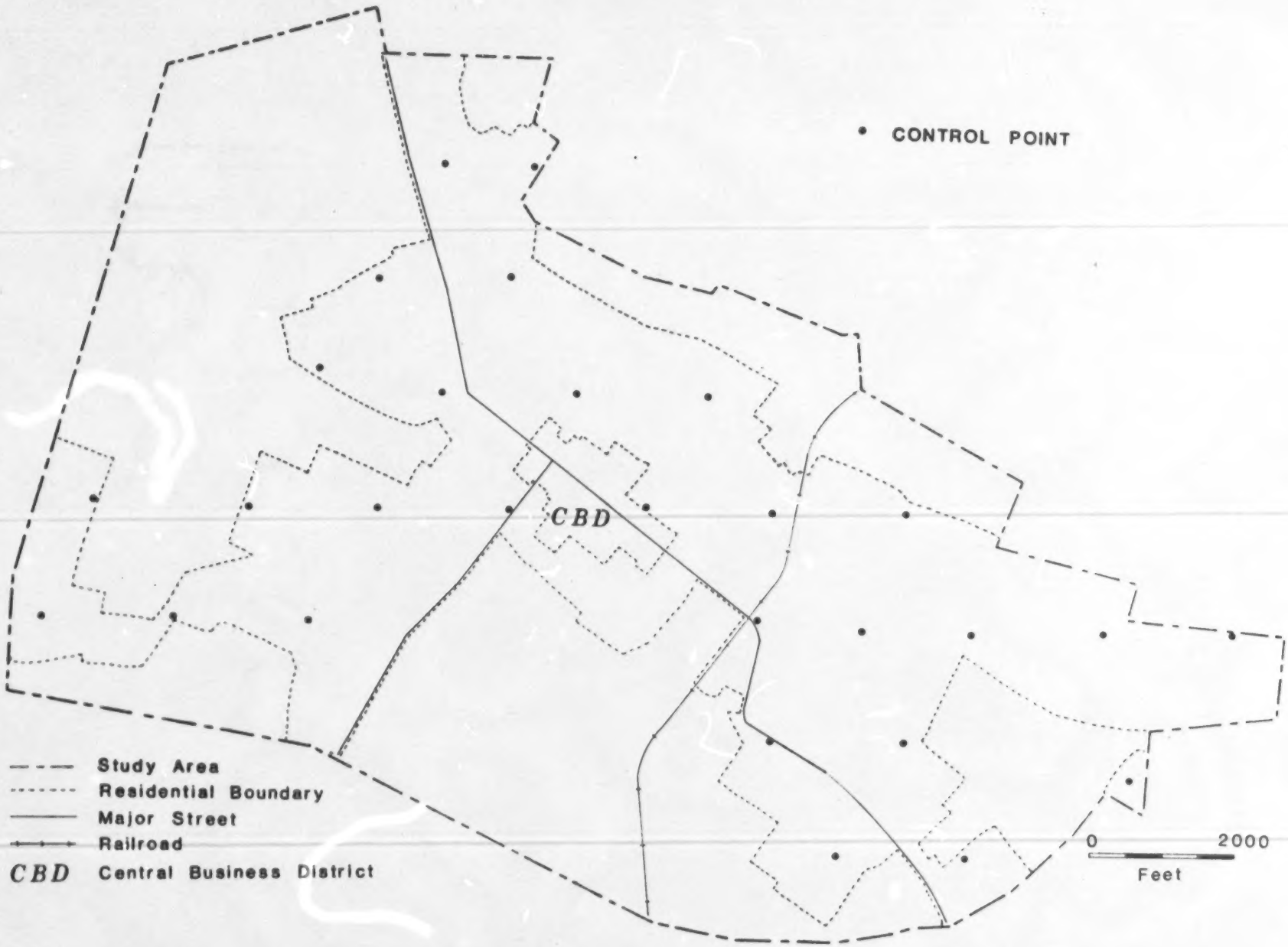

Figure 2. Distribution of Control Points for Isopleth Mapping (After Barnes).

TABLE 1

MATRIX OF KENDALL RANK CORRELATION COEFFICIENTS AMONG MEASURES OF IQ, ACHIEVEMENT, AND CREATIVITY FOR 94 STUDENTS IN THE STUDY AREA

A. FOR 52 STUDENTS IN CITY SYSTEM

Variable	2	3	4	5	6	7
1. IQ	.0592	.1808	.0139	.0131	.5938	.4442
2. Fluency		.6552	.6496	.2148	.0868	.0552
3. Flexibility			.4963	.1630	.0904	.1783
4. Originality				.1934	.1509	.0046
5. Elaboration					.0038	.0324
6. Reading Achievement						.4637
7. Math Achievement						

KENDALL TAU .1874 SIGNIFICANT AT .05 LEVEL
KENDALL TAU .2466 SIGNIFICANT AT .01 LEVEL

B. FOR 42 STUDENTS IN COUNTY SYSTEM

Variable	2	3	4	5	6	7
1. IQ	.0867	.0376	.1852	.3385	.6924	.6789
2. Fluency		.6361	.1844	.1985	.0036	.0097
3. Flexibility			.2018	.0995	.1309	.0757
4. Originality				.1177	.2669	.0454
5. Elaboration					.2921	.2818
6. Reading Achievement						.5699
7. Math Achievement						

KENDALL TAU .2101 SIGNIFICANT AT .05 LEVEL
KENDALL TAU .2766 SIGNIFICANT AT .01 LEVEL

The median student scores on IQ, achievement, and creativity tests were computed within each of the control areas and were recorded at each control point location along with the neighborhood quality index. The rank correlation matrix developed from data at these control points suggests that IQ is significantly associated spatially with achievement and neighborhood quality and that neither of these variables is significantly associated spatially with either of the creativity measures (Table 2). The low correlations between neighborhood quality and achievement are probably attributable to two factors: 1) a general deficiency of achievement within the study area among all students and 2) inadequacies in the mental images of neighborhood quality among city officials. The latter case is discussed below.

Three isopleth maps were generated from the data recorded at the control points to illustrate the spatial character of neighborhood quality, IQ, and originality. Because there is a high positive rank correlation between IQ and achievement for the control areas, only the map of the IQ variable was produced. Originality was mapped to represent the creativity variables, although either of the other measures could have been chosen.

The spatial pattern of neighborhood quality defined by city officials suggests that the west side of town generally contains the higher quality residential space (Figure 3). The poorest quality residences are located in a relatively large area east of the central business district. This zone is the most conspicuous one in the area. Neighborhood quality increases east of this zone toward the city's margin where recently developed sub-divisions are located. An exception is a mobile home park located on the extreme eastern margin of the city and classified lower than nearby neighborhoods. Division of residential space into two broad zones of quality, such as the higher quality west side and lower quality east side in this case, is typical of small towns.

TABLE 2

MATRIX OF KENDALL RANK CORRELATION COEFFICIENTS AMONG MEASURES OF IQ, ACHIEVEMENT, CREATIVE THINKING, AND NEIGHBORHOOD QUALITY FOR 31 EQUAL SIZE AND EVENLY DISTRIBUTED CONTROL AREAS

Variable	2	3	4	5	6	7	8
1. IQ	.0515	.1157	.1530	.0886	.4345	.4013	.3660
2. Fluency		.4214	.3578	.2775	.2098	.1116	.0023
3. Flexibility			.3691	.0132	.0053	.0593	.2333
4. Originality				.0968	.0368	.0360	.0858
5. Elaboration					.0999	.2030	.0744
6. Reading Achievement						.5132	.0701
7. Math Achievement							.0369
8. Neighborhood Quality							

KENDALL TAU .2479 SIGNIFICANT AT .05 LEVEL
KENDALL TAU .3264 SIGNIFICANT AT .01 LEVEL

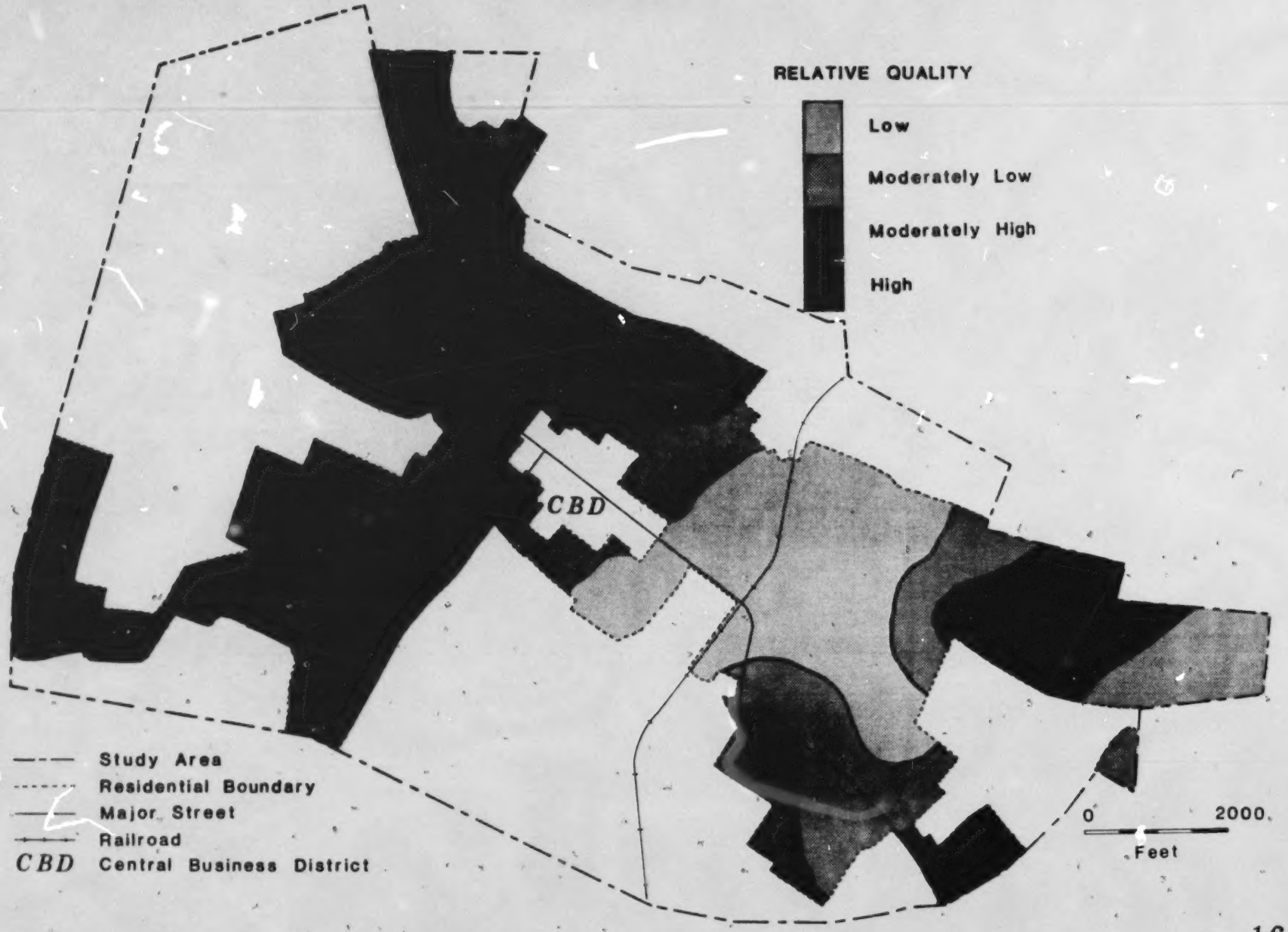

Figure 3. Mental Images of Neighborhood Quality.

The pattern of median IQ scores is strikingly similar to that of neighborhood quality, especially on the east side of town (Figure 4). The inconsistencies in the two patterns on the west side of town are best explained as slight inaccuracies in neighborhood quality classification by the city officials. For example, the small zone of low IQ northwest of the central business district is also a public housing area overlooked in the neighborhood quality classification. The patterns of IQ and neighborhood quality are, however, very similar, especially the close correspondence between low IQ and low neighborhood quality on the east side.

The spatial character of originality is quite different from that of IQ and neighborhood quality in this case (Figure 5). It is probably not valid to think about a spatial pattern of creativity. With what is it spatially associated? Although the patterns of IQ and neighborhood quality are not reversed on the originality map, obvious differences exist among the maps of these variables. Occurrence of two zones of low originality on the west side of town and of a zone of high originality on the east side suggests a different spatial pattern of mental ability from the traditional view. Also, note the high originality in the public housing area northwest of the CBD.

CONCLUSION

Are there spatial patterns of mental abilities in this small town? The correlation analysis and maps illustrate the significant spatial association among IQ, its counterpart achievement, and socio-economic conditions. These variables exhibit obvious spatial patterns commensurate with popular mental images held by many citizens. The argument that IQ and achievement tests are culturally biased, however, is supported by this evidence.

The mental ability creativity is not spatially associated with the

Figure 4. Spatial Pattern of Median IQ Scores.

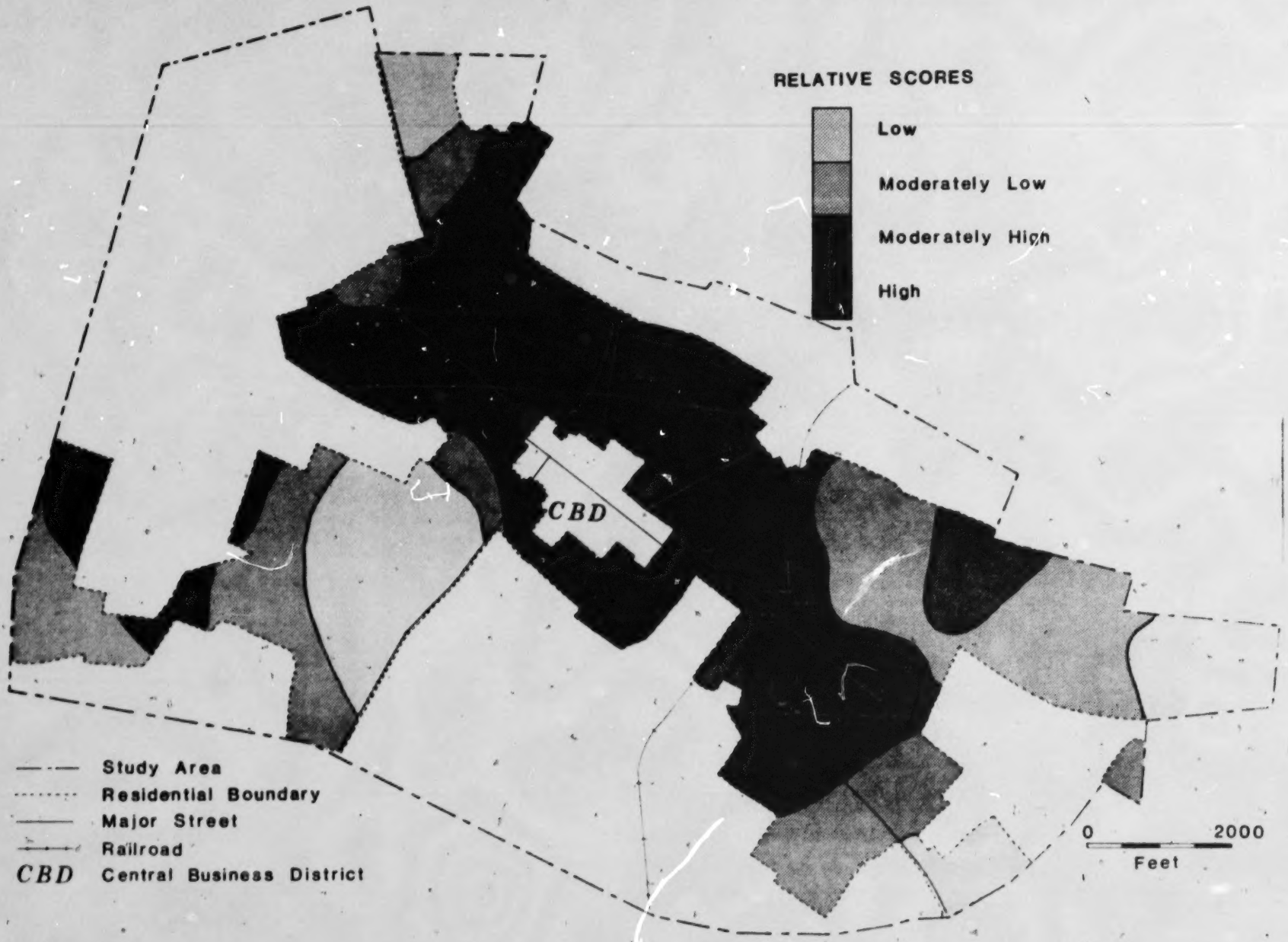

Figure 5. Spatial Pattern of Median Originality Scores.

other variables. That the originality map does not correspond to the neighborhood quality map suggests that creativity tests are not culturally biased. The relatively high scores on the creativity test by children residing in poor quality neighborhoods supports Torrance's contention that creativity measures identify potentialities in culturally disadvantaged children that might otherwise be overlooked.

Perhaps the findings in this case study are not applicable to other places. In this case, however, some myths about the distribution of mental abilities have been challenged. One in particular comes to mind. In the study area no one with whom this study was discussed believed that children from poor neighborhoods could compete favorably with children from more desirable socio-economic areas on a test of mental ability. These doubters included school counselors, teachers, parents, and university professors and students. Comparison of the three maps has raised some interesting questions among these people about their prejudice.

At the start I stated that my purpose for this study is personal. The evolution of my interest in the central question includes being assigned the task of teaching a 9th grade "dumb class" in geography several years ago. The reality that within individual schools children are segerated on the basis of their performance on tests biased against them is frightening, especially when one discovers the obvious potentialities possessed by these children. But to know that the schools in entire communities are segregated in a related fashion is even more alarming.

FOOTNOTES

1) The name of the city in which this study was conducted is omitted to preserve the confidential nature of the data.

2) Arthur R. Jensen, "How Much Can We Boost IQ and Scholastic Achievement?" Harvard Educational Review (Winter, 1969), p. 75.

3) I am aware of only one attempt to map the spatial pattern of public school student test scores. In 1966, a student of Professor of Geography James A. Barnes at the University of Georgia prepared such a map in Athens, Georgia. The map has since been lost.

4) Jensen, 1-123.

5) E. Paul Torrence, Norms Technical Manual: Torrance Tests of Creative Thinking (Lexington, Mass: Ginn and Company, 1974).

6) Ibid.

7) E. Paul Torrance, "Are the Torrance Tests of Creative Thinking Biased Against or in Favor of Disadvantaged Groups?" Gifted Child Quarterly (Summer, 1971), 75-80.

8) Torrance, Norms Technical Manual: TTCT.

9) Hubert M. Blalock, Jr., Social Statistics (New York: McGraw-Hill Book Co., 1972), p. 18.

10) Jensen, p. 44.

11) Blalock, pp. 361-95.

12) Ibid., pp. 415-21.

13) James A. Barnes, "Control Areas and Control Points in Isopleth Mapping," The American Cartographer(April, 1978), 65-69.

14) E. Paul Torrance, "The Minnesota Studies of Creative Behavior: National and International Extensions", The Journal of Creative Behavior (Spring, 1967), p. 138.